

Claims

What is claimed is:

1. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing, comprising:

a first passageway member pivotally coupled at an inboard end thereof to a rotunda and supported close to an outboard end thereof by a ground support member;

a telescopic passageway member having an inboard end and an outboard end and including at least two passageway elements, one that is telescopically received within the other such that a distance between the inboard end and the outboard end of the telescopic passageway member is variable, the telescopic passageway member for being supported in a cantilever-like fashion such that the telescopic passageway member is moveable over the wing of the aircraft;

a flexible connection disposed for pivotally coupling the outboard end of the first passageway member and the inboard end of the telescopic passageway member, and for supporting a vertical swinging motion of the outboard end of the telescopic passageway member relative to the first passageway member;

an adjustable support mechanism mounted at a first end thereof to a surface of the first passageway member and mounted at a second opposite end thereof to a surface of the telescopic passageway member, for vertically swinging the telescopic passageway member relative to the first passageway member in a controllable manner;

an actuator coupled to the adjustable support mechanism, for driving the adjustable support mechanism so as to vertically swing the telescopic passageway member relative to the first passageway member in the controllable manner; and,

an electrical controller in communication with the actuator for providing a control signal to the actuator, the control signal for use by the actuator to controllably vary the angle between the first passageway member and the telescopic passageway member about the flexible connection.

2. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 1, comprising a cabin pivotally mounted at the outboard end of the telescopic passageway member for engaging the rear doorway of the aircraft.

3. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 1, wherein each one of the first passageway member and the telescopic passageway member includes a floor member, two sidewall members and a ceiling member, and wherein the flexible connection comprises a hinge-like element disposed between the outboard end of the floor member of the first passageway member and the inboard end of the floor member of the telescopic passageway member.
4. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 3, wherein the flexible connection further comprises a flexible canopy disposed between the outboard end of the first passageway member and the inboard end of the telescopic passageway member, for providing substantially continuous weather-resistant protection to passengers moving therebetween.
5. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 1, wherein each one of the first passageway member and the telescopic passageway member includes a floor member, two sidewall members and a ceiling member, and wherein the flexible connection comprises a hinge-like element disposed between the outboard end of the ceiling member of the first passageway member and the inboard end of the ceiling member of the telescopic passageway member.
6. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 1, wherein the ground support member comprises a wheel carriage having drive wheels for frictionally engaging a ground surface.
7. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 6, wherein the wheel carriage includes an adjustable support element for affecting the height of the outboard end of the first passageway member.
8. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 7, wherein the adjustable support element includes a mechanical stop for arresting a downward motion of the outboard end of the first passageway member at a predetermined height.

9. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 8, wherein the adjustable support element includes a cam in communication with the mechanical stop, for varying the predetermined height.
10. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 1, wherein the first passageway member comprises at least two passageway elements, one that is telescopically received within the other, such that a distance between the inboard end and the outboard end of the first passageway member is variable.
11. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 1, wherein the adjustable support mechanism comprises a linearly actuatable mechanism pivotally mounted at one end to the first passageway member and pivotally mounted at a second opposite end to the telescopic passageway member, whereby extending the linearly actuatable mechanism controllably lowers the outboard end of the telescopic tunnel section and retracting the linearly actuatable mechanism controllably raises the outboard end of the telescopic tunnel section.
12. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 11, wherein the linearly actuatable mechanism is selected from a group consisting of: a fluid pressure ram; and, an electromechanical screw.
13. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 12, wherein the fluid pressure ram comprises one of a pneumatic ram and a hydraulic ram.
14. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 12, wherein the electromechanical screw comprises an electromechanical ball screw jack, selected from the group consisting of: a redundant ball path electromechanical screw jack; and, an electromechanical ball screw jack having an acme thread.
15. A method of automatically aligning a passenger loading bridge to an aircraft having a rear doorway aft of or over a wing, the passenger loading bridge having an aircraft engaging end

including a first passageway member that is coupled at an outboard end thereof to an inboard end of a telescopic passageway member via a flexible connection, the method comprising:

- providing the passenger loading bridge;
- moving the aircraft engaging end of the passenger loading bridge over the wing of the aircraft and toward an expected stopping position for the rear doorway of the aircraft;
- providing a control signal to an actuator of the passenger loading bridge, the control signal for use by the actuator for driving an adjustable support mechanism of the passenger loading bridge; and,
- in dependence upon the provided control signal, controllably adjusting the adjustable support mechanism so as to effect a change to an angle between the first passageway member and the telescopic passageway member about the flexible connection, such that a known minimum clearance is maintained between the aircraft engaging end of the passenger loading bridge and the wing of the aircraft.

16. A method according to claim 15, wherein moving the aircraft engaging end of the passenger loading bridge over the wing of the aircraft and toward an expected stopping position for the rear doorway of the aircraft is performed in an automated fashion.

17. A method according to claim 15, comprising:
positioning the flexible connection of the passenger loading bridge approximately above a leading edge of the wing of the aircraft and at a height that is sufficient for maintaining the known minimum clearance between the aircraft engaging end of the passenger loading bridge and the wing of the aircraft.

18. A method according to claim 17, comprising:
coupling the aircraft engaging end of the passenger loading bridge to the rear doorway of the aircraft;
when coupled, sensing a vertical displacement of the wing of the aircraft relative to the aircraft engaging end of the passenger loading bridge; and
automatically moving the aircraft engaging end of the passenger loading bridge in dependence upon the sensed vertical displacement of the wing of the aircraft, so as to maintain the known minimum clearance.

19. A method according to claim 17, comprising prior to moving the aircraft engaging end of the passenger loading bridge toward the expected stopping position for the rear doorway of the aircraft, receiving an enabling signal for enabling an automated bridge control system of the passenger loading bridge to automatically align the aircraft engaging end of the passenger loading bridge to the rear doorway of the aircraft.

20. A method according to claim 19, wherein the enabling signal is transmitted using a transmitter disposed aboard the aircraft.

21. A method according to claim 19, comprising prior to moving the aircraft engaging end of the passenger loading bridge toward the expected stopping position for the rear doorway of the aircraft:

- determining a type of the aircraft; and,
- retrieving information relating to the expected stopping position for the rear doorway of the determined type of the aircraft.

22. A method according to claim 21, wherein determining a type of the aircraft comprises: in dependence upon receiving the enabling signal, capturing an image of the aircraft; characterizing the image of the aircraft to extract features relating to the aircraft; comparing the extracted features with stored template features; and, identifying the type of the aircraft in dependence upon a result of the comparison.

23. A method according to claim 21, wherein determining a type of the aircraft comprises: extracting from the enabling signal data relating to the type of the aircraft; and, based on the extracted data, identifying the type of the aircraft.

24. A method according to claim 17, wherein moving the aircraft engaging end of the passenger loading bridge toward an expected stopping position for a rear doorway of an aircraft comprises:

- sensing a distance between the aircraft engaging end of the passenger loading bridge and the aircraft;
- comparing the sensed distance to the known minimum clearance; and,

when the sensed distance is i) one of greater than and equal to the known minimum clearance, continuing the movement of the aircraft engaging end of the passenger loading bridge toward the expected stopping position for the rear doorway for the determined type of aircraft, and ii) less than the known minimum clearance, moving the aircraft engaging end of the passenger loading bridge along a predetermined escape route in a direction away from the aircraft.

25. A method according to claim 17, wherein moving the aircraft engaging end of the passenger loading bridge toward an expected stopping position for a rear doorway of an aircraft comprises:

sensing a distance between the aircraft engaging end of the passenger loading bridge and the aircraft;

comparing the sensed distance to the known minimum clearance; and,

when the sensed distance is i) one of greater than and equal to the known minimum clearance, continuing the movement of the aircraft engaging end of the passenger loading bridge toward the expected stopping position for the rear doorway for the determined type of aircraft, and ii) less than the known minimum clearance, adjusting the position of the aircraft engaging end of the passenger loading bridge such that, during a future motion, the sensed distance is at least equal to the known minimum clearance.

26. A method according to claim 17, wherein moving the aircraft engaging end of the passenger loading bridge toward an expected stopping position for a rear doorway of an aircraft comprises:

sensing a distance between a point along the lower surface of the aircraft engaging end of the passenger loading bridge and a corresponding point on the wing of the aircraft; and,

adjusting a height of the aircraft engaging end of the passenger loading bridge such that the point along the lower surface of the aircraft engaging end of the passenger loading bridge is at least the predetermined minimum safe distance above the corresponding point on the wing of the aircraft.

27. A method according to claim 26, wherein adjusting a height of the passenger loading bridge comprises vertically raising the flexible connection relative to the wing of the aircraft.

28. A method according to claim 26, wherein adjusting a height of the passenger loading bridge comprises:

- raising the flexible connection relative to the wing of the aircraft;
- extending a length of the telescopic passageway member; and,
- reducing an angle between the first passageway member and the telescopic passageway member about the flexible connection.

29. A method according to claim 26 wherein the step of adjusting a height of the passenger loading bridge comprises the steps of:

- lowering the flexible connection relative to the wing; of the aircraft
- retracting a length of the telescopic passageway member; and,
- increasing an angle between the first passageway member and the telescopic passageway member about the flexible connection.

30. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing, the passenger loading bridge comprising:

- a first passageway member having a length, an inboard end and an outboard end distal from the inboard end, the first passageway member pivotally coupled at the inboard end thereof to a rotunda, the outboard end for being positioned in a direction toward an aircraft;

- a telescopic passageway member having an inboard end and an outboard end and including at least two passageway elements, one that is telescopically received within the other such that a distance between the inboard end and the outboard end of the telescopic passageway member is variable, the telescopic passageway member for being supported in a cantilever-like fashion such that the telescopic passageway member is extensible over a wing of an aircraft;

- a flexible connection disposed between the first passageway member and the telescopic passageway member for pivotally coupling the outboard end of the first passageway member and the inboard end of the telescopic passageway member, for supporting a vertical swinging motion of the outboard end of the telescopic passageway member relative to the inboard end of the telescopic passageway member and about an approximately horizontal axis; and,

a height-adjustable support member mounted to an external surface of the first passageway member at a point along the length of the first passageway member that is distal from the outboard end of the first passageway member, such that the flexible connection is positionable above and approximately aligned with a highest point of a wing of an aircraft.

31. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 30, wherein a distance between the point along the length of the first passageway member and the flexible connection is between approximately 3 feet and approximately 10 feet.

32. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 31, wherein the distance between the point along the length of the first passageway member and the flexible connection is between approximately 4 feet and approximately 8 feet.

33. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 31, comprising an adjustable support mechanism including a first end mounted to the first passageway member and including a second end mounted to the telescopic passageway member, whereby varying a distance between the first end of the mechanism and the second end of the mechanism effects a pivoting motion of the outboard end of the telescopic passageway member relative to the inboard end of the telescopic passageway member.

34. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 33, wherein the adjustable support mechanism comprises a linearly actuatable mechanism, whereby extending the linearly actuatable mechanism controllably lowers the outboard end of the telescopic tunnel section and retracting the linearly actuatable mechanism controllably raises the outboard end of the telescopic tunnel section.

35. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 34, wherein the linearly actuatable mechanism is selected from a group consisting of: a fluid pressure ram; and, an electromechanical screw.

36. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 35, wherein the fluid pressure ram comprises one of a pneumatic ram and a hydraulic ram.
37. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 35, wherein the electromechanical screw comprises an electromechanical ball screw jack, selected from the group consisting of: a redundant ball path electromechanical screw jack; and, an electromechanical ball screw jack having an acme thread.
38. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 30, wherein the height-adjustable support member comprises a wheel carriage for supporting a horizontal swinging motion of the passenger loading bridge relative to the rotunda.
39. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 38, wherein the wheel carriage includes drive wheels for frictionally engaging a ground surface.
40. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 30, comprising a cabin pivotally mounted at the outboard end of the telescopic passageway member for engaging a rear doorway of an aircraft.
41. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 30, wherein the first passageway member comprises a fixed-length passageway element having a cross-section normal to the length of the first passageway member and wherein the one of the at least two passageway elements of the telescopic passageway member has a substantially same cross-section normal to a longitudinal axis thereof.
42. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 30, wherein the first passageway member comprises at least two passageway elements, one that is telescopically received within the other, such that a distance between the inboard end and the outboard end of the first passageway member is variable.

43. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing, the passenger loading bridge comprising:

- a first passageway member pivotally coupled at an inboard end thereof to a rotunda and supported close to an outboard end thereof by a ground support member;

- a telescopic passageway member having an inboard end and an outboard end and including at least two passageway elements, one that is telescopically received within the other such that a distance between the inboard end and the outboard end of the telescopic passageway member is variable, the telescopic passageway member for being supported in a cantilever-like fashion such that the telescopic passageway member is moveable over the wing of an aircraft;

- a flexible connection for pivotally coupling the outboard end of the first passageway member and the inboard end of the telescopic passageway member, for supporting a vertical swinging motion of the outboard end of the telescopic passageway member relative to the first passageway member; and,

- an adjustable support system comprising:

- at least a lift mechanism having a first end and a second end that is opposite the first end, a distance between the first end and the second end being controllably variable, the first end of the at least a lift mechanism pivotally mounted to a surface of the first passageway member at a location elevationally below a ceiling member thereof and proximate an end thereof, and the second end of the at least a lift mechanism pivotally mounted to a surface of the telescopic passageway member at a location elevationally below a ceiling member thereof and proximate an end thereof, the end of the first passageway member and the end of the telescopic passageway member being disposed in a facing arrangement one each on opposite sides of the flexible connection, such that varying the distance between the first end and the second end of the at least a lift mechanism effects a change to the angle between the first passageway member and the telescopic passageway member about the flexible connection.

44. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 43, comprising:

an actuator for controllably varying the distance between the first end and the second end of the at least a lift mechanism; and,

an electrical controller in communication with the actuator, for providing a control signal to the actuator for varying the distance between the first end and the second end of the at least a lift mechanism, so as to effect a change to the angle between the first passageway member and the telescopic passageway member about the flexible connection.

45. A passenger loading bridge for servicing an aircraft having a rear doorway aft of or over a wing according to claim 43, wherein the at least a lift mechanism comprises two linearly actuatable mechanisms, one disposed adjacent to sidewall members along a first side of the passenger loading bridge and the other disposed adjacent to sidewall members along a second opposite side of the passenger loading bridge.